

CLAIMS

What is claimed is:

- 1 1. A method comprises:
 - 2 forming a phase shift mask having a periodic pattern of etched regions and unetched
 - 3 regions;
 - 4 performing a first exposure to a photoresist layer formed on a substrate through the
 - 5 phase shift mask;
 - 6 laterally offsetting the phase shift mask; and
 - 7 performing a second exposure to the photoresist layer through the laterally offset
 - 8 phase shift mask.
- 1 2. The method of Claim 1 wherein said photoresist is a negative photoresist.
- 1 3. The method of Claim 1 wherein said phase shift mask is formed of quartz.
- 1 4. The method of Claim 2 further comprises:
 - 2 developing said negative photoresist layer; and
 - 3 etching said substrate using said developed photoresist layer as a etch mask.
- 1 5. The method of Claim 1 wherein said periodic pattern is a checkerboard pattern of
- 2 etched regions and unetched regions.

6. The method of Claim 1 wherein said periodic pattern comprises alternating stripes of etched regions and unetched regions.

7. The method of Claim 5 wherein said lateral offsetting comprises shifting said phase shift mask in both an x direction and a y direction.

8. The method of Claim 7 wherein said offsetting has a magnitude less than a dimension of said etched region.

9. The method of Claim 6 wherein said lateral offsetting comprises rotating said phase shift mask.

10. The method of Claim 10 wherein said rotating is a ninety-degree rotation.

11. The method of Claim 1 wherein said lateral offsetting comprises rotating and shifting said phase shift mask.

12. The method of Claim 1 wherein said etched regions have a portion of the phase shift mask removed to a depth sufficient to cause exposing radiation passing through to be 180 degrees out of phase with radiation passing through said unetched regions.

1 13. A semiconductor product having contact holes formed by:
2 forming a phase shift mask having a repetitive pattern of etched regions and unetched
3 regions;
4 performing a first exposure to a photoresist layer formed on a substrate through said
5 phase shift mask;
6 laterally offsetting the position of said phase shift mask relative to said photoresist
7 layer;
8 performing a second exposure to said photoresist layer through said laterally offset
9 phase shift mask;
10 developing said photoresist layer; and
11 etching said contact holes in said substrate using said developed photoresist layer as a
12 mask.

1 14. The product of Claim 13 wherein said photoresist used is a negative photoresist.

1 15. The product of Claim 13 wherein said phase shift mask used is formed from quartz.

1 16. The product of Claim 13 wherein said repetitive pattern of the phase shift mask used
2 is a checkerboard pattern of etched regions and unetched regions.

1 17. The product of Claim 13 wherein said repetitive pattern of the phase shift mask used
2 comprises alternating stripes of etched regions and unetched regions.

1 18. The product of Claim 16 wherein said lateral offsetting comprises shifting said phase
2 shift mask in both an x direction and a y direction.

1 19. The product of Claim 18 wherein said offsetting has a magnitude less than a
2 dimension of said etched region.

1 20. The product of Claim 17 wherein said lateral offsetting comprises rotating said phase
2 shift mask used.

1 21. The product of Claim 20 wherein said rotating is a ninety-degree rotation.

1 22. The product of Claim 13 wherein said etched regions have a portion of the phase shift
2 mask used are removed to a depth sufficient to cause exposing radiation passing therethrough
3 to be 180 degrees out of phase with radiation passing through said unetched regions.

1 23. A method comprises:
2 using a phase shift mask to perform a first exposure of a photoresist layer formed atop
3 of a substrate, wherein said phase shift mask includes etched regions and unetched regions;
4 adjusting the positioning of said phase shift mask relative to said photoresist layer;
5 performing a second exposure of said photoresist layer;
6 developing said photoresist layer; and
7 using said photoresist layer as a mask to etch said substrate.

1 24. The method of Claim 23 wherein said photoresist is a negative photoresist.

1 25. The method of Claim 23 wherein said etched regions and said unetched regions form
2 a repetitive checkerboard pattern.

1 26. The method of Claim 23 wherein said etched regions and said unetched regions form
2 repetitive pattern of alternating stripes.

1 27. The method of Claim 23 wherein said offsetting comprises shifting said phase shift
2 mask in both an x direction and a y direction.

1 28. The method of Claim 27 wherein said offsetting has a magnitude less than a
2 dimension of said etched region.

1 29. The method of Claim 23 wherein said offsetting comprises rotating said phase shift
2 mask.

1 30. The method of Claim 23 wherein said offsetting comprises rotating and shifting said
2 phase shift mask.

1 31. The method of Claim 23 wherein said etched regions have a portion of the phase shift
2 mask removed to a depth sufficient to cause exposing radiation passing therethrough to be
3 180 degrees out of phase with radiation passing through said unetched regions.